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Title: Laboratory Strategy for the Future

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Los Alamos
NATIONAL LABORATORY
EST. 1943

Los Alamos National Laboratory:

Laboratory Strategy for the Future

Dr. Charles F. McMillan

September 25, 2017

NNSA
National Nuclear Security Administration

The Laboratory is an integrated and dynamic system of people, facilities, equipment, materials, and services that support our national security mission

Weapons Programs
- Weapons Physics Design
- Weapons Physics Computation
- Weapons Engineering
- High Explosives
- Plutonium
- Tritium/GTS
- Uranium, Be, Salts, Metals
- Detonators
- Component Fabrication and Assembly
- Integrated and Environmental Testing

Science, Technology and Engineering
- Chemistry, Earth and Life Sciences
- Accelerator Science
- Engineering Sciences
- Materials and Physical Sciences
- Theoretical and Computational Sciences

Director's Office
- Institutional Management

Global Security
- Nuclear Nonproliferation
- Nuclear Counter-proliferation
- Non-nuclear Threats
- Energy and Resource Security

Waste Management
- Enduring Waste
- Legacy Waste

Institutional Operations
- Business Services
- ES&H
- Nuclear & High Hazards Ops
- Security and Mission Assurance

Capital Projects
- Project Management Services

36 square miles 47 technical areas 1,280 buildings/ 9M sq. ft. 11 nuclear facilities 268 miles of roads

8,000 career employees 2,280 R&D scientists and engineers 380 postdocs 1,700 students at peak

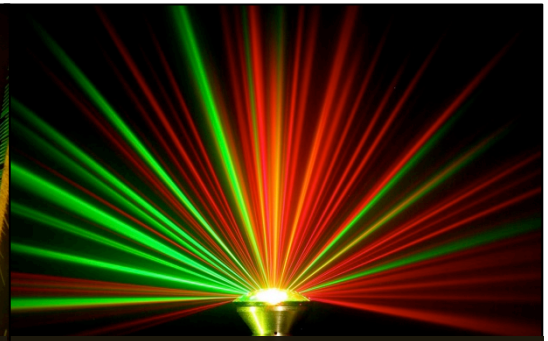
$2.5B budget 57% Weapons Program 4,700 projects 600 B&R codes

5 PADS 14 Directorates 80 Divisions

Los Alamos' core mission is to ensure the U.S. nuclear deterrent

- Ensure safety, reliability, and performance of U.S. nuclear stockpile
- Design agency for four out of seven warhead systems constituting our nation's deterrent
- Modeling, simulation, radiography, and non-nuclear testing provide assurance

Modeling & simulation



Specialized experiments

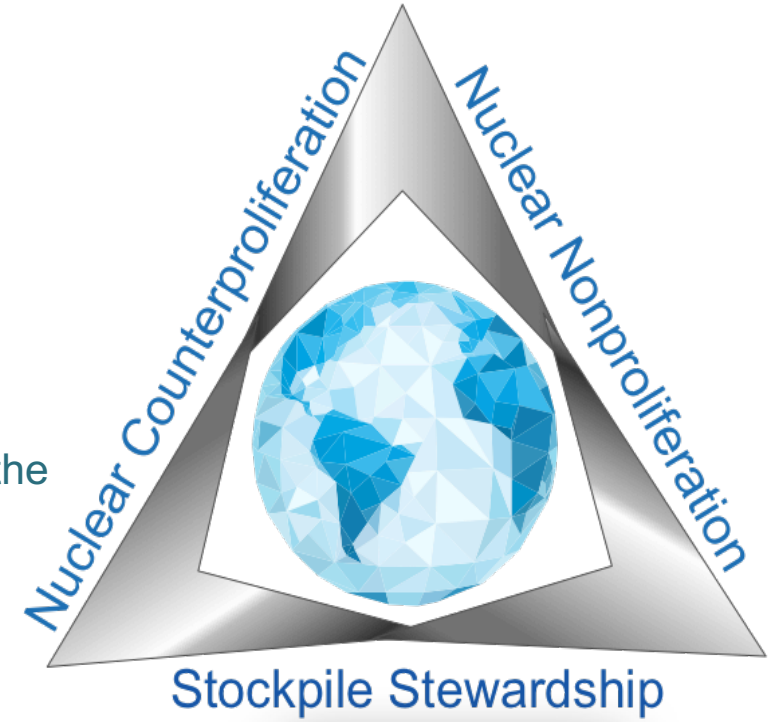
Supercomputing

DARHT – Dual axis x-ray

Los Alamos uses scientific assessment, experimentation, & modeling to assess and certify the stockpile, which has aged significantly since it was first developed and since the conclusion of full-scale testing

Los Alamos' broader national security missions comprise strategic deterrence

Detecting and preventing the development or use of nuclear weapons and improvised devices

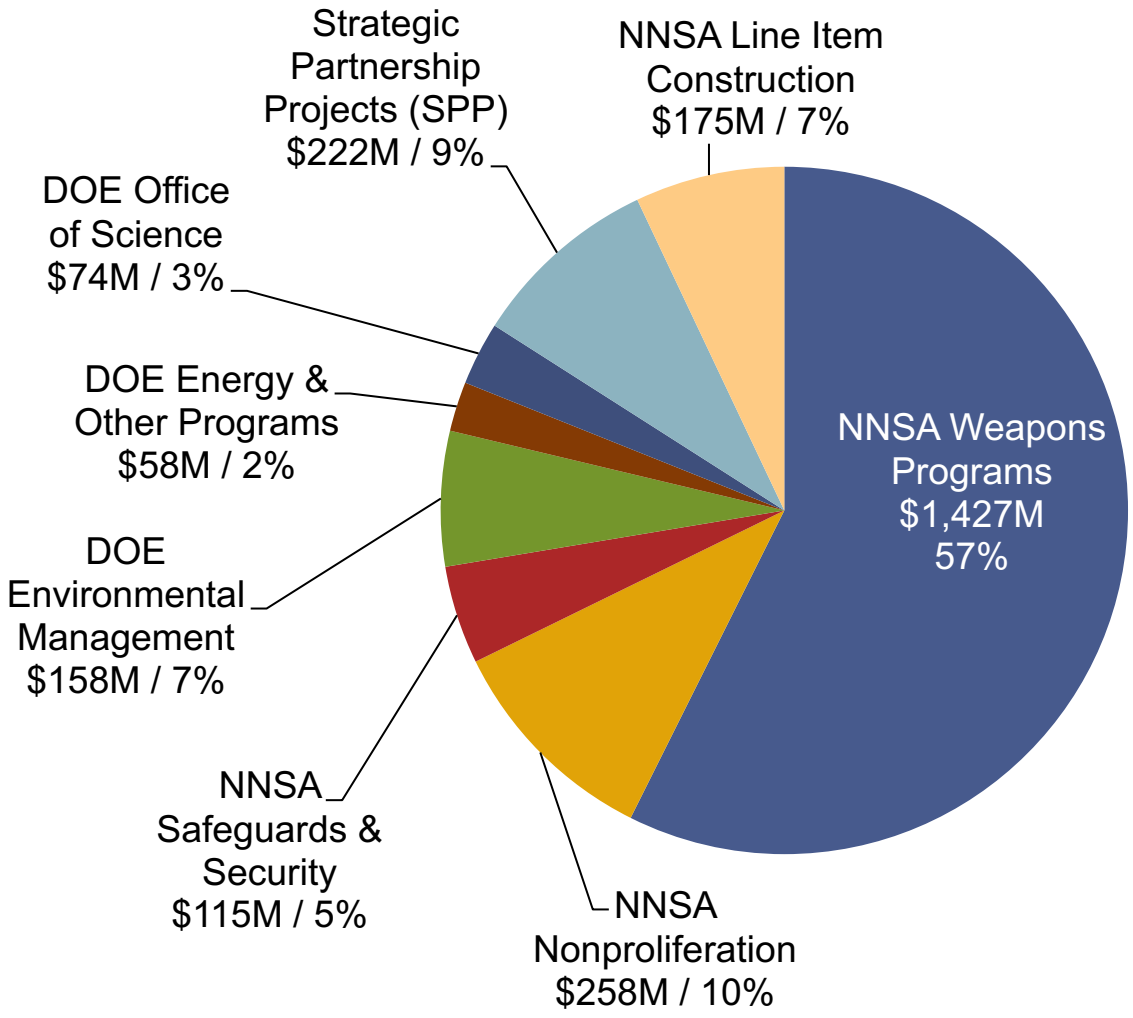


NUCLEAR SAFEGUARDS
LOS ALAMOS NATIONAL LABORATORY

Reducing nuclear arms and limiting the spread of nuclear technology, material, and expertise through cooperation and diplomacy

Providing the foundation for global security programs through theory, modeling and simulation, and experimentation

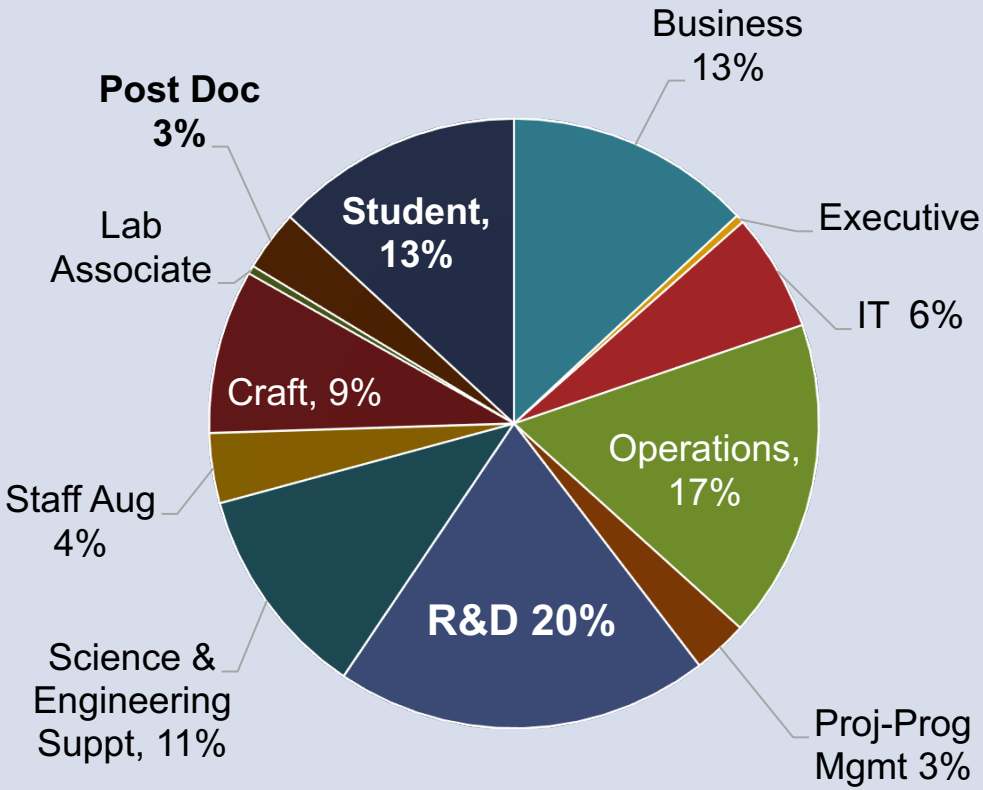
As a National Security Lab, applying multidisciplinary capabilities is inherent in our broad funding



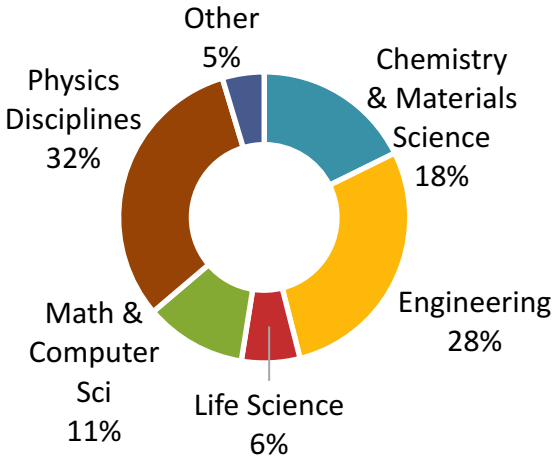
FY17 Estimated Budget Authority: $2.49B

Approximately 11,100 National Security specialists collaborate in a wide variety of technical disciplines

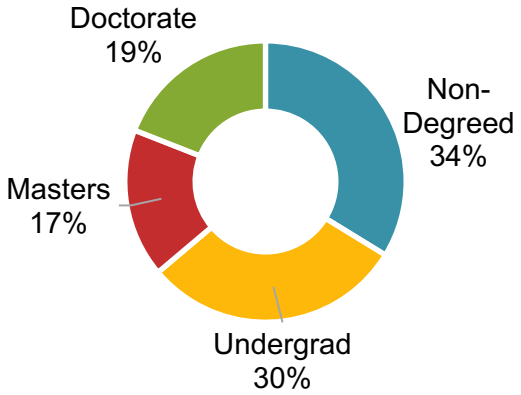
Employee Categories



R&D Employee Disciplines



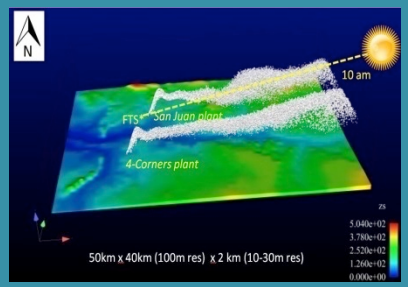
Degreed Workforce



Our Science Pillars define strategic capability investment areas at Los Alamos for present and future missions

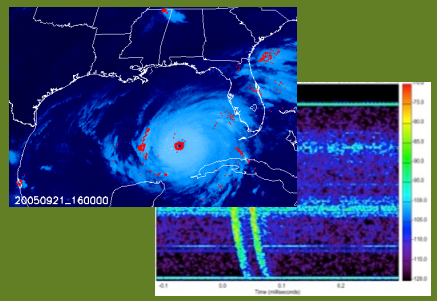
Materials for the Future

- Defects and Interfaces
- Extreme Environments
- Emergent Phenomena



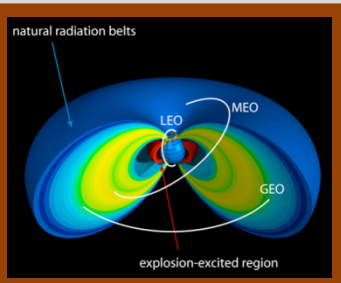
Science of Signatures

- Discover Signatures
- Revolutionize Measurements
- Forward Deployment



Information, Science, and Technology for Prediction

- Complex Networks
- Computational Co-Design
- Data Science at Scale



Nuclear and Particle Futures

- High Energy Density Physics & Fluid Dynamics
- Nuclear & Particle Physics, Astrophysics & Cosmology
- Applied Nuclear Science & Engineering
- Accelerators & Electrodynamics

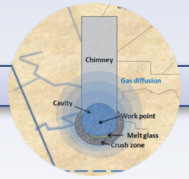
Science Pillars support capabilities across the Laboratory and Missions

The integration of science, engineering, and mission enables agile responses to national security challenges

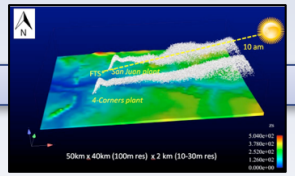
PAST → FUTURE

SUBSURFACE

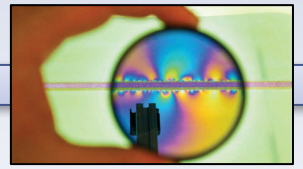
Containment
(Large events)



Nonproliferation and verification

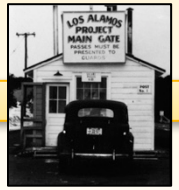


Environment:
Atmospheric & subsurface

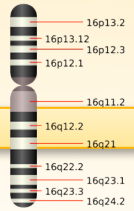


Small event detection,
Fracture formation,
Weapons performance

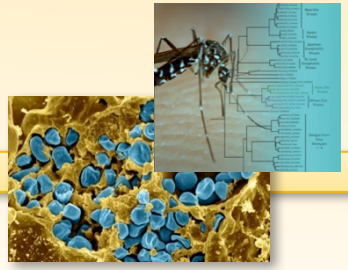
BIOSECURITY



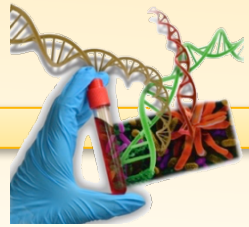
Radiation
health effects



Human Genome
Project

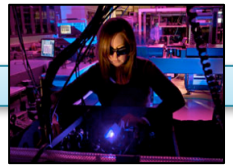


Biosurveillance, Disease
tracking

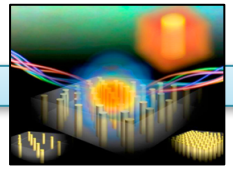


Bioinformatics, Cancer research,
Data science at scale

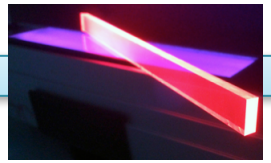
NANOSCIENCE



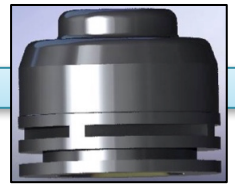
Foundational nanoscale
materials research



Metamaterials

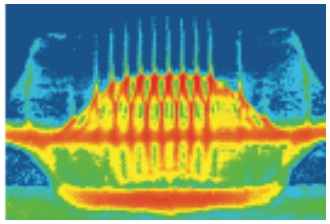


Nanocrystal quantum dots,
Energy applications



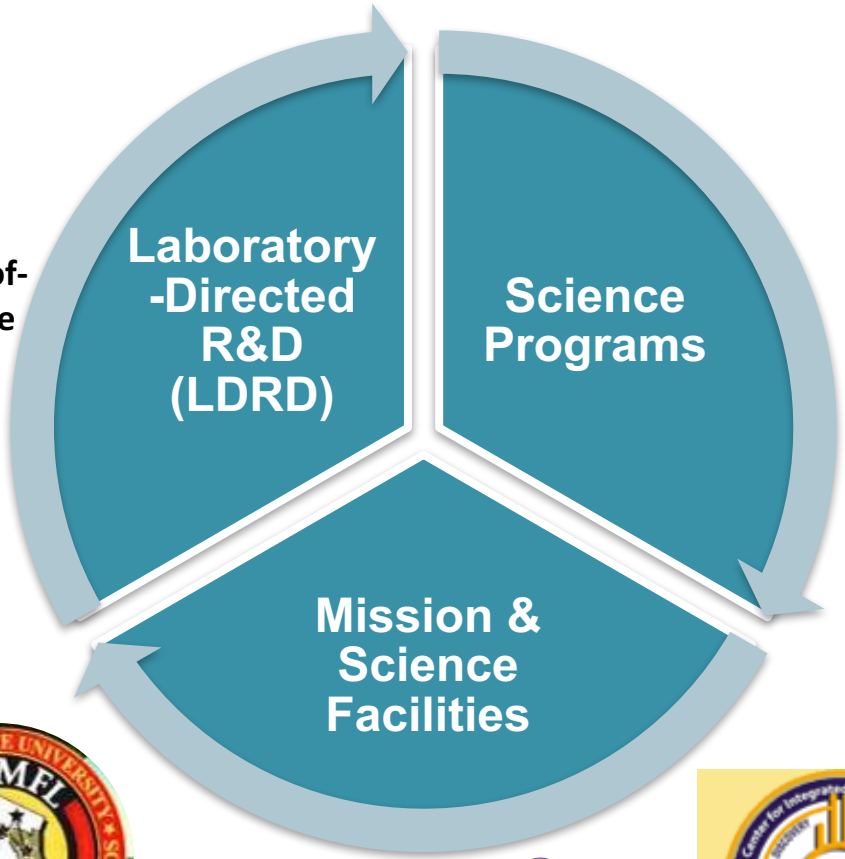
Engineered materials with
controlled functionality

We sustain these capabilities through the synergy of strategic science programs, cutting-edge LDRD science, and our unique mission and science facilities



LDRD investment enabled proof-of-principle development of the novel radiographic technique, called proton radiography;

pRad is now used to study materials and validate models in stockpile stewardship experiments



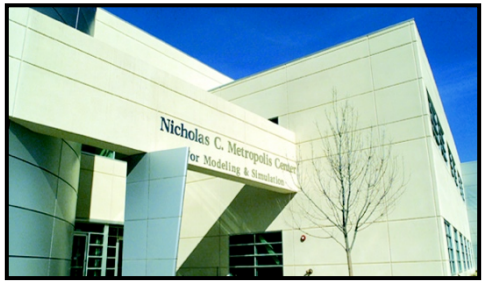
Los Alamos leads the Exascale Co-Design Center for Materials in Extreme Environments — developing a multi-physics exascale simulation framework for modeling materials subjected to extreme mechanical and radiation environments

Research with high magnetic fields

Neutron scattering

Nano-material synthesis and characterization

Unique science and engineering infrastructure is critical for national security work



Metropolis Center for Modeling & Simulation

Los Alamos Neutron Science Center

Dual Axis Radiographic Hydrotest Facility

Plutonium Processing Facility (TA-55)

National High Magnetic Field Laboratory

Center for Integrated Nanotechnologies

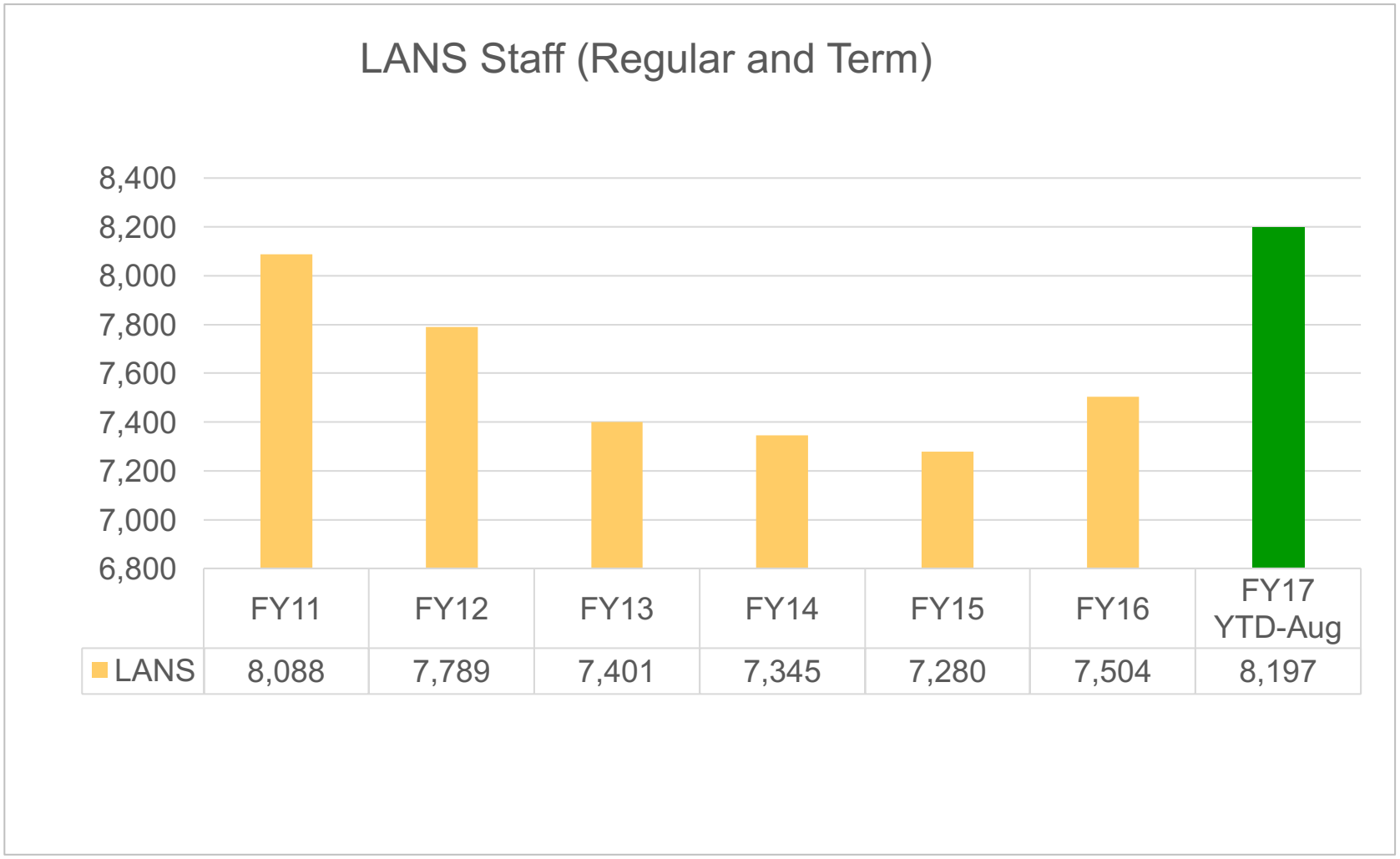
- 40 square miles
- 47 technical areas
- 2,000 structures
- 1,280 buildings
- 13 nuclear facilities

High Explosive Laboratories

And many more…

CMR Replacement (CMRR) Building

Attracting and retaining a quality workforce is vitally important to the future of the Laboratory

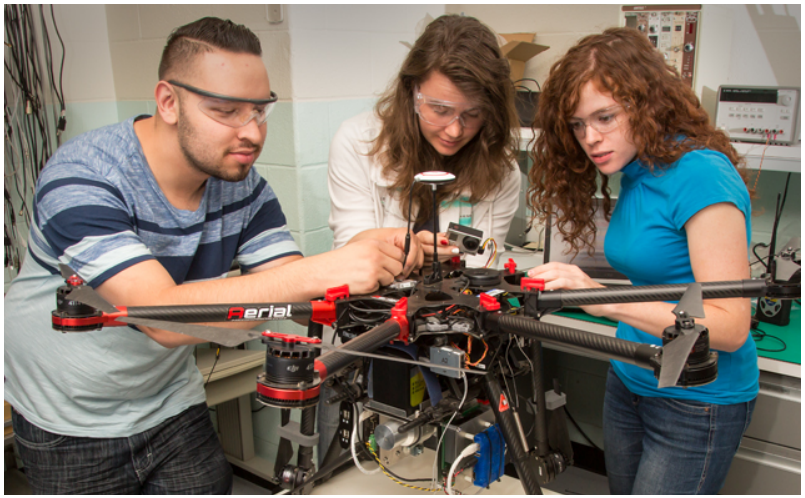


We have a high return on student and postdoc pipeline investments

- LANL anticipates *ca* 2,200 vacancies between 2017–2020, in all areas
- Healthy student and postdoc programs are vital to the Laboratory's early-career pipeline
- Over 2,200 students and postdocs worked at LANL in FY17
- LANL's National Security Education Center serves a collaboration, education, and recruitment role for the Laboratory

Percentage of new hires in FY16 who were former students or postdocs

17%	52%	73%
All new hires	All R&D hires	Non-mgmt PhD tech staff hires



Los Alamos innovations open up opportunities for "win-win" partnerships in strategic areas

Safire multiphase flow meter technology

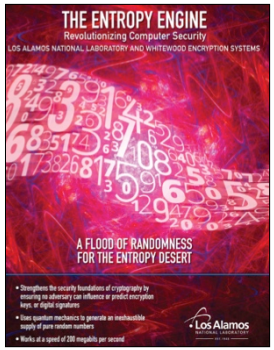
- Collaboration with General Electric Company and Chevron
- Invented by Los Alamos scientists, Safire provides noninvasive, continuous, and accurate estimates of oil production.

Next-generation data storage technologies

- Collaboration with Seagate, a U.S. data storage company
- Under a CRADA, Seagate and Los Alamos are developing power-managed disk and software solutions for deep data archiving and other next-generation technologies

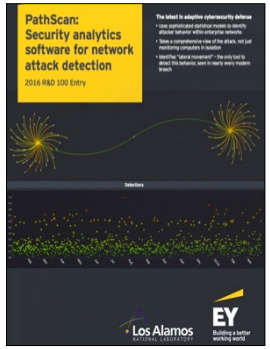
Computer security

- Entropy Engine employs quantum mechanics to solve the problem of entropy generation, the critical foundation to all cryptographic systems currently in use today
- Whitewood licensed the technology, which is now commercially available



Network attack detection

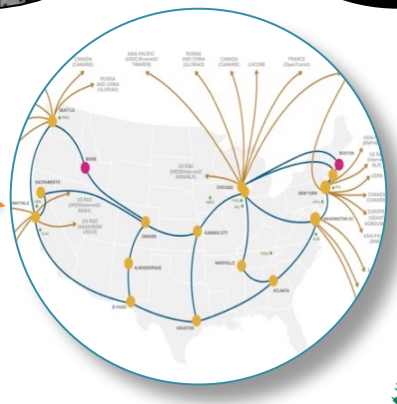
- Ernst & Young LLP and Los Alamos teamed up to launch PathScan
- Provides security analytics for computer network attack detection; now available to the commercial market



The nexus of universities, National Labs, and industry enhances opportunities for partnerships, collaborations

Universities

- PI- and peer-driven research on a project-by-project basis
- Diverse funding environment
- Most abstract research



Industry

- Connection to market, national needs
- Pragmatic R&D

DOE National Labs

- Team science
- Facilities and projects of scale
- Interdisciplinary Integrator for long term, mission-driven research

UNM

New Mexico CONSORTIUM

UC San Diego JACOBS SCHOOL OF ENGINEERING

UNIVERSITY OF CALIFORNIA

ElectroCat Electrocatalysis Consortium

LightMAT Lightweight Materials Consortium

OAK RIDGE National Laboratory

Sandia National Laboratories

Lawrence Livermore National Laboratory

ERNST & YOUNG

WHITEWOOD

Backup Slides

Universities attending REACT workshop